Book Reviews

BELOW THE SEA FLOOR

Initial Reports of the Deep Sea Drilling Project

Vol. 1: Orange, Texas to Hoboken, NJ, August–September 1968. Pp. xx + 672. $10.25. Vol. 2: Hoboken to Dakar, Senegal, October–November 1968. Pp. xx + 490. $8.25. (Prepared for the National Science Foundation, National Ocean Sediment Coring Program by the University of California, Scripps Institution of Oceanography.) (US Government Printing Office: Washington DC, February 1970.)

On August 12, 1968, the drilling vessel Glomar Challenger began boring its first hole in the Gulf of Mexico. Compared with the aims of the Mohole project, which was finally abandoned two years earlier, the aims of the Deep Sea Drilling Project were modest: the acquisition of information pertaining to the history of the ocean basins.

These two splendidly produced and illustrated volumes cover the first two legs of the project. On the first leg various holes were drilled in the Gulf of Mexico and the eastern North Atlantic; the second group of drillings took place in the North Atlantic on a line between New York and Dakar. The volumes contain excellent descriptions of the holes drilled and the rocks found in them; but are written mostly in technical language, with the detailed results on which any conclusions are based. They will provide a superb foundation for future work on the drilling cores, but neither they nor the shorter cruise reports of later legs convey any of the excitement which the project has generated. Nor do they (and indeed nor should they!) make any attempt to discuss the wider implications of the results of these studies.

Before this project began little was known about the sediments and volcanic rocks below the sea floor. The soft surface sediments had been cored to a depth of 10 m in many places, and loose fragments of basalt and other basic and ultrabasic rocks had been dredged. The age and composition of the huge wedges of sediment which extend from the continental slopes beneath the abyssal plains were, however, quite unknown. Before samples of these rocks had been obtained, many geologists claimed that the few rocks now exposed on the continent had been deposited in the deep ocean basins. As soon as cores of these rocks were obtained, however, they were found to be remarkably similar to the rocks which form some major mountain belts.

Perhaps the youth of the ocean basins and their economic importance are the two most surprising and important results of the deep drilling programme. When drilling began in 1968 the theory of sea floor spreading had just become accepted by most geophysicists, and large parts of the world's oceans had been dated by using the characteristic shape of magnetic anomalies observed at the sea surface. There was, however, rather little evidence to support the reversal time scale used for this purpose. The spreading rates obtained from the magnetic anomalies also required almost all the ocean floor to have been produced in the 200 m.y. since the Jurassic, or in the last twentieth of the geological record. Therefore if these results were correct the ocean floor had to be very much younger than the continents, where rocks of 3,000 m.y. have been found in several regions. The deep drilling results have supported all these suggestions in the most remarkable way. Particularly impressive is the comparison of the dates obtained from microfossils just above the basalt in the South Atlantic with the dates from the magnetic anomalies[1]. The agreement between the two is remarkable, and removes any lingering doubts about sea floor spreading and plate tectonics.

The other major result of this programme is the discovery of deposits of salt, sulphur, oil and copper beneath the deep ocean. A salt dome in the Gulf of Mexico was drilled during the first leg, and the rocks obtained contained a considerable quantity of oil and sulphur. The first of these volumes contains a description of the exhaustive experiments which were carried out to show that the rocks are identical in almost all respects to the cap rock of certain Gulf Coast salt domes. Seismic reflection records in the Gulf of Mexico show that there are a great many of these structures beneath the sea floor, many of which are likely to have trapped oil. Salt domes have also been found in deep water beyond the continental edge in the North Atlantic, and these also should have trapped oil. How the salt is formed is far from clear; Ewing *et al.* in volume one remark: "The regional problem which probably will be most earnestly debated is whether this salt was deposited in its present deep water environment, or on a crust which was once much shallower". Both proposals have major objections. Though there is not yet any method of exploiting the oil deposits trapped by the salt, there is little doubt that the intriguing technical problems can be overcome and the oil extracted. The quantities involved will probably equal or exceed those on land. The other major economic find is native copper, found on leg 11 in the deep ocean off Cape Hatteras. This discovery is less surprising than the salt domes because the oceanic crust consists of layered basic intrusive complexes, and most continental economic deposits of copper, chromium and nickel are associated with such complexes, some of which may be fragments of uplifted oceanic crust. The present drilling ship can only drill through a few metres of basalt, and therefore cannot hope to reach most of these ores. Perhaps it will soon be possible to revive the Mohole project under a different name and justify it on economic grounds alone. Let us hope that the exploitation of these enormously valuable deposits will not be permitted until it can be done without polluting the oceans with waste products and escaped oil.

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[1] Maxwell, A. E., Von Herzen, R. P., Hsü, K. J., Andrews, J. E., Saito, F., Percival, jun., S. F., Milow, E. D., and Boyce, R. E., *Science*, **168**, 1047 (1970).

WEDDELL'S VOYAGE SOUTH

A Voyage towards the South Pole performed in the Years 1822–24

Containing an Examination of the Antarctic Sea (1827). By James Weddell. Pp. x + 324. (David and Charles Reprints: Newton Abbot, June 1970. First published in 1825.) 75*s*.

On February 20, 1823, the Jane of Leith, a 60 ton sealer under the command of Captain James Weddell, a retired master in the Royal Navy, reached latitude 74° 15′ S, in longitude 34° 16′ a point in that great bight of the Antarctic continent which Weddell named for George IV, but which was soon to become better known as the Weddell Sea. He was only 945 miles distant from the South Pole and virtually open water lay in all directions. This remarkable southing beat Cook's previous record of 71° 10′ S and was itself not to be surpassed in this sector until 1912 when the German, Wilhelm Filchner, attained 77° 44′ S in the Deutschland. It marked an epoch in the history of Antarctic exploration by pointing to one of the principal routes to the far south, but one that in most seasons is so ice infested that few vessels can penetrate it. Dumont d'Urville, Wilkes and Clark Ross